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भारतीय मानक
Indian Standard

घरेलू मीथेनोल कूकस्टोव — केनीस्टर टाइप — विशिष्टि

Domestic Methanol Cookstove — Canister Type — Specification

ICS 97.040.20

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Oil Burning Appliances Sectional Committee, MED 26

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Oil Burning Appliances Sectional Committee had been approved by the Mechanical Engineering Division Council.

India, with a vision of providing clean, cost-effective, and locally available cooking fuel, has launched first canister based ‘Methanol Cooking Fuel Program’. This program explores the feasibility of using methanol as cooking fuel for household, commercial and institutional cooking applications. It is informed that methanol is a much cleaner fuel and use of this fuel can provide a cleaner alternative in rural areas for those families which are not covered under the Pradhan Mantri Ujjwala Yojna (LPG) and Government of India estimates that even partial use of methanol would reduce the country’s cooking fuel import bill by $100 billion and pollution up to 40 percent. This Indian Standard on domestic methanol cookstove-canister Type has been formulated with the objective to provide consumers with domestic cookstoves which provide quality workmanship, safety and efficiency. This Indian standard also covers the allowable leakage level of methanol fuel used in the cookstoves.

In view of the relevance of this product, NITI Aayog requested BIS for a National Standard on the subject matter. Subsequently, R & D exercise was carried out by research team of Prof P Muthukumar, Smt Pratibha Maurya and Shri Lav Kumar Kaushik, from IIT Guwahati.The draft Standard proposed by IIT-Guwahati, which after due deliberations with the Oil Burning Appliances Sectional Committee MED 26 and its panel has been finalized.

As per Rule 4 of the Petroleum Rules, 2002, containers exceeding one litre in capacity for petroleum Class A and five litre in capacity for petroleum Class B or Class C shall be of the type approved by the Chief Controller.

The composition of the committee responsible for the formulation of this standard is given in Annex G.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
DOMESTIC METHANOL COOKSTOVE — CANISTER TYPE — SPECIFICATION

1 SCOPE

1.1 This standard specifies construction, operation, safety requirements and tests for canister based domestic cookstoves with metallic bodies intended for use with methanol at normal atmospheric pressure.

1.2 This Indian Standard also specify the characteristics of methanol to be used as a fuel in the Domestic Methanol cook stoves and various safety precautions to be followed while operating the stove and storing the canister. It also highlights the permissible limits of methanol vapour during operation/non-operation of the stove and storage of the canister.

1.3 For convenience, this standard has been divided into four sections which are as follows:

a) Section 1 Construction
b) Section 2 Performance
c) Section 3 General *and*
d) Section 4 Safety precaution.

2 REFERENCES

The standards listed in Annex A, contain the provisions which, through their reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards in Annex A.

SECTION 1 CONSTRUCTION

3 TERMINOLOGY

For the purpose of this standard, the nomenclature of the different parts of the canister-based methanol domestic cookstove shall be as indicated in Fig.1.

3.1 *Cannister* — A canister is a round or cylindrical container used for storing methanol fuel. Lateral surface of the canister is termed as the cassette and the cover over top surface as the cassette cover.

3.2 *Cannister Lid* — A canister lid is provided to close the open top surface of canister to avoid the leakage of methanol vapour.

4 FUEL CAPACITY

4.1 The canisters shall be made to have a nominal capacity of 1.8 ± 0.1 litre. The capacity shall be measured by filling methanol to the maximum capacity of the canister without spillage. There shall be no leakage of liquid fuel even if canister is tilted to 180° (as fuel is adsorbed on the surface of the mineral wool).

4.2 The canister shall be able to sustain the stable flame during its entire combustion, that is, from 100 percent to 15 percent of the fuel capacity and in the entire range of specified power level (0.4 kW -1.5 kW).

5 GENERAL

5.1 The construction of all the parts of the cookstove shall be sound and of high standard of workmanship and appropriate finishing. The construction shall ensure durability and shall comply with the safety requirements.

5.2 Seating arrangement of the canister should be made such that, the gap between the canister's open surface and the canister opening lever should be less than 0.5 mm to minimize the leakage of Methanol. Preferably an O-ring made up of soft metal or high temperature neoprene rubber can be used for preventing the leakage of methanol from the gap.

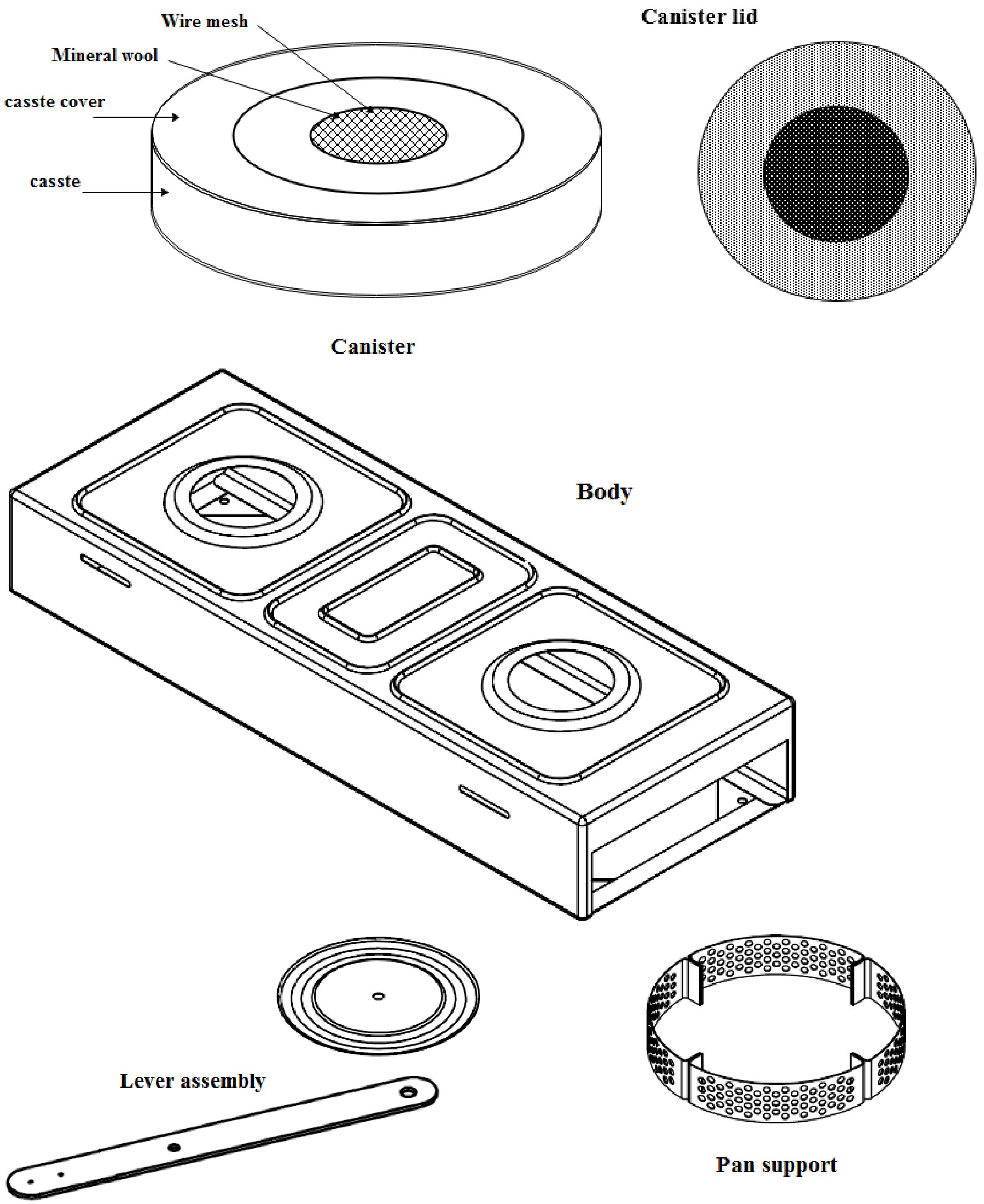


FIG. 1 METHANOL COOKSTOVE, CANISTER TYPE, TYPICAL

5.3 The overall design and construction of the canister based cookstove should be such that methanol concentration of below the recommended limit 200 in ppm results in its usage in the measured in the kitchen size of range of 5 m^3 -100 m^3 with an air exchange rate of 5-45 per h with cookstove burn time of 2-4 h.

5.4 Press joining process shall be used for manufacturing of canister.

6 MATERIALS

6.1 The materials shall comply with the specified relevant Indian Standard (Annex A) and shall be appropriate with the conditions arising in the part of the cookstove in which they are used. The cookstove shall be free from swarf, grit, and other foreign matters. Material used in the manufacture of different parts shall be such that they would ensure safe handling and good performance of the cookstove throughout its reasonable life.

6.2 Fuel Canister

6.2.1 Canister cassette and the cassette cover shall be made of stainless steel as per IS 6911. Canister lid shall be made up either of rubber or any flexible material which can withstand up to 100°C temperature and shall not allow the leakage of methanol vapour. Mineral wool shall be used inside the canister for the storage of Methanol fuel as per IS 3144.

6.2.2 Mineral wool inside the canister shall be packed in such a way that the normal evaporation rate (without combustion) of methanol at atmospheric pressure shall be less than 10 g/h.

6.2.3 Canister shall be removed from the stove after cooking (nearly 10 min after the lever is turned off) and shall be closed with canister lid.

6.3 Plastic components which are liable to get heated (for example, lever handle etc.) shall be free of fissures, distortion, blemishes and discoloration and shall not show signs of ageing when tested as per Annex B of IS 5116.

6.4 The material used in the construction of the cookstoves shall be resistant to wear and deterioration during its normal usage.

6.5 Holding part/handle of the lever shall be made up of thermosetting plastic to avoid the unwanted heating of handle when stove is in operation

7 SHAPE AND DIMENSIONS

7.1 Common shape of a canister-based methanol domestic cookstove is shown in Fig.1. The general construction may be of single-canister or double canister type.

7.2 The cookstove shall be made in sizes according to its capacity as given in **4.1**. The overall dimensions of canister, the frame and cookstove shall be as agreed between the purchaser and the manufacturer. However, the cookstoves so manufactured shall satisfy all the performance requirements.

7.3 The minimum sheet thickness of the fuel canister and frame shall not be less than 0.6 mm when measured at any point.

8 CONSTRUCTION

8.1 The frame of the cookstove shall be so made as to be firm on its base. The fuel canister shall be detachable. Canister shall slide freely inside the housing slot given in the stove and shall take its position on its own. Accordingly, stopper slots shall be provided underneath the stove.

8.2 The fuel canister inside the stove's body during working operation of the stove shall be firm on its base. The stopper slots provided underneath the stove shall provide support in operation too.

8.3 Cookstove shall be capable of being tilted in any direction from the vertical position, to an angle of at least 15^o, without overturning at that inclination or on its release after that.

8.4 The fuel shall not come out of the canister when fully filled under atmospheric pressure and tilted to 180^o. Accordingly, the mineral wool packing shall be done.

8.5 Construction of lever shall be in such a manner, while switching off the canister, lever should completely close the opening part of the canister and the flame should turn off immediately.

9 DESIGN FOR MAINTENANCE

9.1 The cookstove, including all the components, shall be easy to clean and maintain in good working order. There shall be easy access to the control and accessories for the maintenance and adjustment.

9.2 The parts of the cookstove shall not be disconnected during operation. The canisters shall be so spaced that the relative distance between the centres and that of the adjoining canisters shall not be less than 180 mm.

9.3 Canisters of same rating, model and make, shall be interchangeable or replaceable without affecting the overall performance.

9.4 Parts, which are intended to be removable by the user, shall be easy to replace correctly, and impossible to assemble incorrectly.

9.5 All nuts, bolts and fittings having spanner flats shall be capable of being removed by suitable spanner or be readily accessible to an adjustable spanner.

9.6 While turning the lever of stove in ‘OFF’ position, the flame from canister should turn off immediately. If not, it is required to operate the lever for several times from ON to OFF position until the canister fire turn off. In such case, there shall be an urgent need of maintenance of (lever assembly) stove body for proper working of stove.

10 WORKMANSHIP AND FINISH

10.1 The finishing of exposed parts shall be durable, without any sharp edges, easy to clean and not subject to excessive deterioration in normal use. Parts, which will come in contact with the foodstuff, shall be capable of being hygienically cleaned. All the finishing, on visual examination, shall show no defects, such as pin-holes, blisters and roughness or exposed areas of metal, which give rise to unduly rapid deterioration in use. The finished components shall meet the requirements covered in **10.2** to **10.4**.

10.2 Vitreous enameled components shall meet the requirements as given in Annex E of IS 5116. The test shall be carried out on a specimen measuring 40 mm × 75 mm prepared from the same base metal and enamel, as the components, and fired along with the components to ensure identical conditions.

10.2.1 A separate specimen shall be used for each test.

10.3 If the body of the stove is electroplated, the top flat surface shall have a coating of a minimum of 10 micron of nickel followed by minimum 0.2 micron of chromium. The coating shall be tested as per the requirements given in **10.3.1, 10.3.2** and **10.3.3**.

10.3.1 The thickness of nickel plating shall be determined by BNF jet method or any other method, such as coulometric method as specified in IS 3203.

10.3.2 *Adhesion Test*

Cut a piece of a plated article. Hold it in a vice and apply a coarse file to the cut edges in such a manner as to raise the deposit. There shall be no separation between the coating and the base metal and the coating shall remain adherent to the base metal.

10.3.3 *Corrosion Resistance Test*

The plated article shall be subjected to a 12 h test as covered in IS 6910. The rating shall be assigned using the methods described in IS 6009.

10.4 Paints or Similar Finishes for Cookstove Body

Surfaces finished with paints or similar material shall conform to the following requirements:

10.4.1 *Resistance to Abrasion*

The painted surface shall be tested for resistance to scratching as described below:

The apparatus required for this test shall be as per Fig. 2, with a 1 mm diameter steel ball fixed at the end of the counterpoised arm which is kept horizontal.

10.4.2 *Method of Test*

Apply the apparatus to the surface under test and move the ball after loading with not less than 1.5 kg with a travel rate of 3 to 4 cm/s relative to the surface. If the indicator bulb lights, the surface is deemed to have been penetrated. Additionally, for metallic paints, a visual examination of the scratch is necessary in order to determine whether the film has been penetrated. The finish is deemed to have failed, if the scratch has jagged edges with width greater than 1 mm or penetration of the entire film. Clean the ball after each test. The ball shall be inspected frequently to verify its diameter i.e. 1 mm sphere.

10.4.3 *Resistance to Heating*

When the appliance is operated at its normal working pressure for a continuous period of 4hours with a pan filled with water placed on the pan support, there shall be no appreciable change of color of any part of the stove and the finish shall not become tacky or show other signs of deterioration. This does not apply to parts, which come in direct contact with the flame.

10.5 The external finished surfaces shall be easily cleanable.

11 STOVE LEVER

11.1 The appliance shall have at least one lever for each canister. Handle of the lever shall not have any sharp edges. Preferably, the levers operating end shall be covered with a thermosetting plastic material for easy handling.

11.2 The 'ON' and 'OFF' status of the stove in terms of the lever position shall be clearly and durably indicated. In case of multiple canisters, indication of the lever and the respective canister operated by it shall be clearly demarcated. All levers shall close in the same direction.

11.3 Levers shall not lead into Gas Passages.

12 PAN SUPPORTS

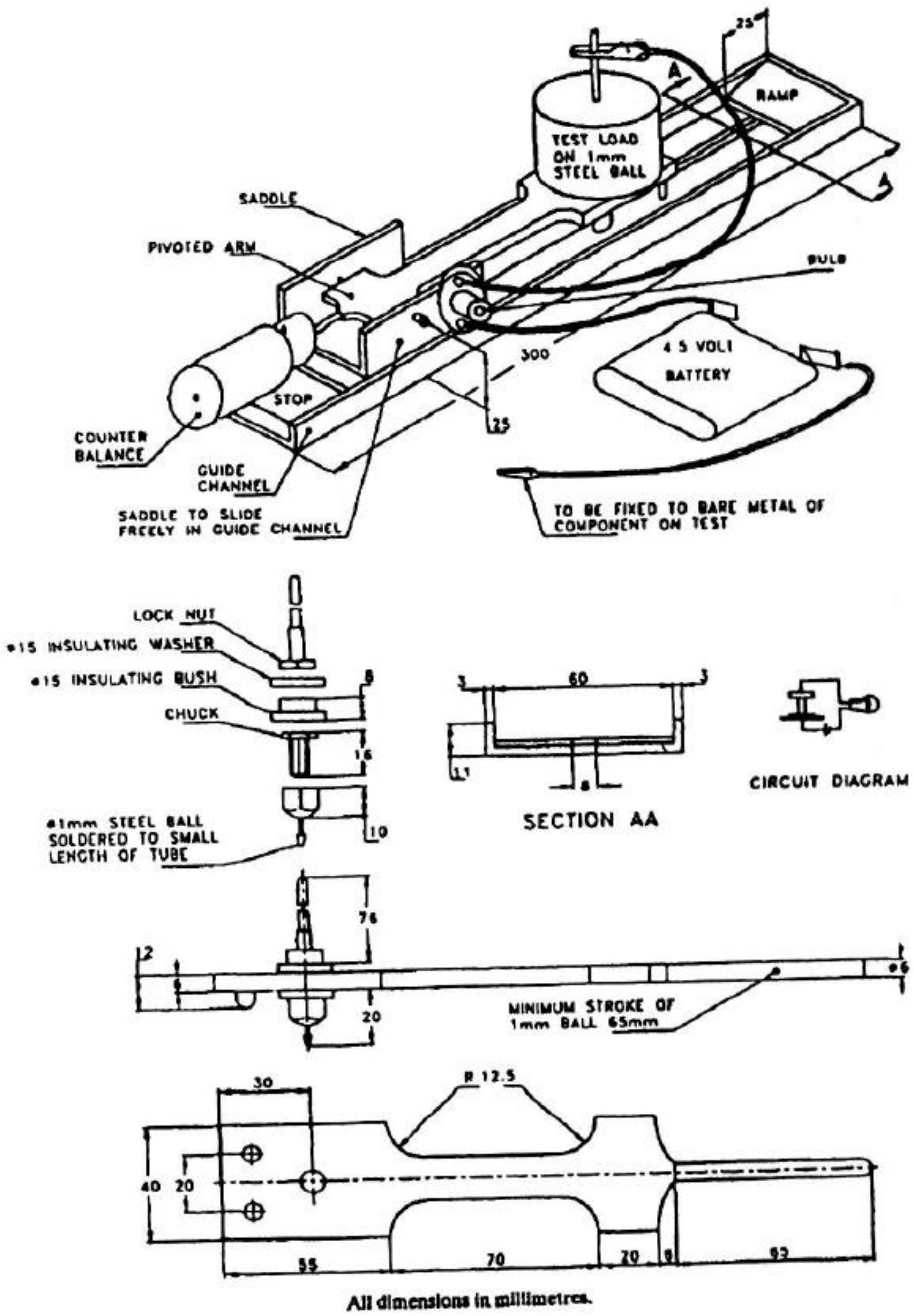
12.1 The design of the pan supports shall be such that a pan of minimum 100 mm diameter over at least one canister without the use of loose rings and also such that a minimum 125 mm diameter vessel remains stable over each pan support. Prongs of the support shall have suitable taper to accommodate round bottom pans.

12.1.1 Loose pan support shall be so designed that it is not possible to place them firmly in other than proper position.

12.1.2 The material of the pan support shall be metallic preferably with high corrosion resistance.

13 STRENGTH AND RIGIDITY OF BODY OF THE COOKSTOVE

When tested as specified in Annex B, the vertical resultant deflection of the top surface measured at the centre along the length of the body, shall not exceed 2 mm and the distance between the opposite sides (lengthwise and width wise) shall not change by more than 5 mm.



All dimensions in millimetres.

FIG. 2 PAINT SCRATCH TEST APPARATUS

SECTION 2 PERFORMANCE

14 GENERAL CONDITIONS OF TEST

14.1 During the tests, the initial adjustment of cookstove shall not be altered unless specifically required in the test procedure. The cookstove shall be adjusted and operated in accordance with the instructions given on or issued with the cookstove. Before any test is made, the cookstove shall be operated at its full working capacity for a sufficient period to remove any temporary protective coating, which might interfere with observations. The methanol canister shall be examined for leaks before and after test. The performance test results shall not be valid unless the system is sound. The cookstove shall be at room temperature at the start of each test unless or otherwise stated.

14.2 The room in which tests are conducted shall be adequately ventilated but free from perceptible draughts.

14.3 Except where otherwise stated, the cookstove shall satisfy the performance requirements using methanol. Wherever the combustion characteristics of canisters are concerned, each canister shall be tested separately and in all possible combinations with other canisters. This procedure shall be used for cookstove with up to four canisters. For cookstove with larger number of canisters, the test procedure becomes impossibly long and discretion shall be exercised to eliminate tests on combinations of widely separated canisters. Canisters which are fitted in cookstove of open construction are unlikely to interfere with the combustion of each other.

15 FUEL CONSUMPTION

15.1 The range of fuel consumption shall range between 180 and 290 g/h.

15.2 The maximum amount of residual methanol left in the canister shall be less than 200 g (or 15 % of the initial charge) for the capacity of 1.42 kg (1.8 litre). It shall be the sole responsibility of manufacturer to collect the used canisters, and recycle or safely dispose off them.

15.3 Each cookstove shall give a fuel consumption in g/h within ±10 percent of the manufacturer’s specified value when tested in accordance with Annex C.

16 THERMAL EFFICIENCY

When tested in accordance with the method described in Annex C, the thermal efficiency of the cookstove shall be not less than 58 percent considering a purity of the fuel within a range of 96 to 99 percent and packing density (porosity) of the glass wool inside the canister shall be evaluated from the mass of the glass wool and the volume of the canister.

16.1 Thermal efficiency may be declared, if it is more than 62 percent or more for the cookstove.

17 SURFACE TEMPERATURE

Temperature of any part of the cookstove that may be necessary to touch during its operation as well as the maximum canister surface temperature attained during three hours’ continuous operation of the cookstove shall not exceed 60ºC, when measured in accordance with method prescribed in Annex D. Temperature of the mineral wool surface (where the combustion of methanol vapour and air takes place) immediately after switching off canister should lie in the range of 40 ºC -50 ºC.

18 COMBUSTION EFFICIENCY

When tested in accordance with the details laid down in Annex E, the Carbon monoxide (CO) to Carbon dioxide (CO_2) ratio of the exhaust gases of each canister, while burning with flame shall not exceed 0.02.

19 RESISTANCE TO DRAUGHT

There shall be no extinction of the flame on the canister while operating at atmospheric pressure when the cookstove is placed in a normal (not localized) current of air with a velocity of 2 m/s, as measured with a rotating vane anemometer. The location of the cookstove relative to neighboring walls and the direction of the draught shall be varied to correspond to likely conditions of appliance installation.

20 FUEL CREEP

When operated under normal conditions, there shall be no spreading of fuel over any part of the cookstove so as to cause undesirable odour or any increase in flame size.

21 SAMPLING

If required, sampling and acceptance criteria for methanol cookstoves may be as agreed between the purchaser and the supplier.

SECTION 3 GENERAL

22 INSTRUCTIONS

Instructions for the safe use of the cookstove shall be supplied with the cookstove in Hindi, English and other regional languages along with pictorial representations. The instruction for safe use shall include the following:

a) Prior to lighting the cookstove, ensure that all the components are undamaged and properly assembled in accordance with the design;
b) Strict prohibition of filling/ refilling of methanol in the canister by the user;
c) The filling/ refilling of methanol in the canister shall be done only by the designated agency / dealers (frequency of refilling cannot be defined, as it is solely depending on the usage).
d) Maximum methanol consumption rate in g/h;
e) Expected thermal efficiency;
f) Methanol filled capacity in litre;
g) Do not place the canister near flammable items;
h) Do not carry or move a cookstove when it is in burning condition;
j) Do not use a cookstove as a heating appliance;
k) Do not breathe in fuel vapours, it may be injurious to health;
m) Do not consume the fuel, it may be fatal;
n) Canister lever shall be always in closed position when the stove is not in operation;
p) Remove the canister from the stove immediately after 10 min of switching off the stove;
q) Canister should be covered with lid when it is kept/stored outside or when not in use;
r) The instructions and warnings shall include an illustration of the assembled appliance or how it shall be assembled;
s) Place the appliance on a reasonably level and stable surface; and
t) Appliance should be used in an adequately ventilated area to ensure satisfactory removal of smoke and fumes due to combustion and to allow circulation of air.

23 MARKING

23.1 The following information should be legibly and indelibly marked in red on each stove body:

a) The user must strictly adhere to Standard Operating Procedure (SOP) for safe usage of cookstove;
b) Manufacturer’s name and/or initials or registered trade-mark;
c) Any special instructions for the safe use of the cookstove;
d) Country of origin;
e) On and off marking on the lever;
f) Expected thermal efficiency; and
g) Remove the canister from the stove immediately after 10 min from turning off the stove and cover it with lid.

23.2 Each canister shall be legibly and indelibly marked with the following:

a) Capacity of methanol canister;
b) Methanol consumption rate in g/h with a tolerance of ± 10 percent (stickers may be used);
c) Rating of the canisters in kJ/h (with commercial methanol);
d) The words "USE LIQUID METHANOL ONLY" on canister;
e) Do not do unauthorized filling;
f) Close the canister with lid while not in use.

23.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

24 PACKING

The Methanol cookstoves shall be packed as agreed to between the purchaser and the supplier, taking care of safety requirements as such during handling and transit to protect against damages.

SECTION 4 SAFETY PRECAUTION

25 SAFETY

25.1 Safety Instruction to be Followed When Cookstove is in Operation

a) Do not breathe vapours (in case the flame goes off, during lightening of the stove avoid breathing of methanol vapour.);
b) The cookstove shall be placed on even surface;
c) The cookstove shall be operated in well ventilated space;
d) The standard kitchen volume should be between 5-100 m^3;
e) The standard air exchange rate in the kitchen 5-45 per h;
f) Maximum permitted continuous operation hours is 4 h.

25.1.1 *First-Aid Measure in Case of Inhalation of Methanol Vapour:*

a) Move the person away for the availability of fresh air and keep him/her comfortable for breathing;
b) If required administer oxygen, in case victim is not breathing provide artificial respiration and get medical attention.

25.1.2 *First-Aid Measure After Direct Eye Exposure to Methanol Vapour*

Immediately rinse with water for at least 15 min. Remove contact lenses, if any. Continue rinsing the eyes with water. Immediately consult a poison center or doctor/physician;

25.1.3 *First-Aid Measure in Case of Ingestion of Methanol Vapour*

Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, keep head low so that vomit does not enter lungs. Never give anything by mouth to an unconscious person. Get medical attention immediately.

25.2 Safety Instructions to be Followed While Taking out the Canister from the Stove's Body

a) Canister shall be left for minimum 10 min inside the body of the stove after switching off the stove i.e. closing the lever in 'OFF' position. The canister shall be removed only after the stipulated period;
b) In case if the stove is not switched off by operating the lever in 'OFF' position. Operate the lever of stove body from 'ON' to 'OFF' position several times until the flame from the canister turn off;
c) If the lever is still not able to turn off the flame, it is required to remove the canister from stove body by using protective gloves and turn off the flame by putting wet woolen clothes on the canister opening;
d) Avoid direct eye contact from canister's opening while taking it out from the body;
e) Keep the canister (fresh/used) within the closed cover and store in a well-ventilated place;
f) Small spills may be remediated with sand or earth and the area may be flushed with water;
g) Large spills shall not be disposed by means of just evaporation, they shall be diluted with water and kept in a glass bottle and later on disposed in a well ventilated and isolated area; and
h) Large spills shall not be disposed in ponds as it may be harmful for aquatic life.

25.2.1 *First-Aid Measures After Skin Contact*

a) Wash affected area with plenty of water for at least 15 min;
b) Remove contaminated clothing and shoes;
c) Wash clothing before reuse;
d) Get medical attention if any symptoms occur.

25.2.2 *First-Aid Measures After Eye Contact*

a) Check for and remove contact lenses;
b) Immediately flush eyes with gentle but large stream of water for at least 15 min, lifting lower and upper eyelids occasionally;
c) Get medical attention.

25.2.3 *First-Aid Measures in General*

a) General Advice: In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible);
b) Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves;
c) Show this safety data sheet to the doctor in attendance.

25.3 Safety Instruction to be Followed for Storing/Disposal of the Canister

When the stove is used for daily cooking, losing fuel from the canister between uses or overnight is not a concern. As long as the stove's canister lever is closed and the stove is kept out of the sun or hot locations, any loss of fuel will be negligible. The following instructions shall be followed for storing/disposal of the canister:

a) Handle empty canister with care because residual vapours are flammable;
b) Keep the canister (fresh / used) within the closed cover and store in a well-ventilated place;
c) Keep canister away from heat, hot surfaces, sparks, open flames and other ignition sources;

d) Do not store the canister with incompatible products such as strong oxidizers i.e. barium, perchlorate, bromine, chlorine, Chloroform, Sodium methoxide. Diethyl zinc, Acetyl bromide, Sodium hypochlorite etc. or metals such as Aluminium, Magnesium, and Potassium.
e) Keep/store away from direct sunlight, extremely high or low temperatures and incompatible material;
f) The canister shall not be racked at height to avoid any sudden fall;
g) Disposal of used canister is manufacturer's responsibility;
h) After every use of stove detach the canister from stove and close the cap/lid of the canister (for storing canister over long periods of time).

26 FIREFIGHTING MEASURES

26.1 Extinguishing Media

Use suitable fire extinguishing media i.e. dry chemical powder, alcohol resistant foam, carbon dioxide (CO_2), water spray and fog. Water may be ineffective because it may not cool the methanol below its flash point.

26.2 Fire Fighting Instruction

Do not breathe fumes from fires or vapour from decomposition. Use water spray or fog for cooling exposed containers.

27 EXPOSURE LIMITS VALUES OR THRESHOLD LIMIT VALUE

The Threshold Limit Value (TLV) of methanol is 200 ppm and Immediately Dangerous to Life or Health (IDLH) value is 6000 ppm. The leakage of methanol from closed canister during non-burning condition, when it is closed with lid, shall be less than 6 g in 24 h, in order to avoid the crossing, the TLV of methanol which is 200 ppm for safe operation. The exposure limit shall be evaluated as per WHO guidelines i.e. for the kitchen size in the range of 5-100 m^3 with the standard air exchange rate in the kitchen 5-45 per h.

NOTE — The exposure limit shall be evaluated as per WHO, Indoor Air Quality Guidelines: Household Fuel Combustion, World Health Organization (2014) 1–172

27.1 Exposure to Gaseous Emission on Combustion

27.1.1 When tested in accordance with the method described in Annex E, the emission level of CO and NOx shall not be more than the levels tabled below:

*CO	< 200 ppm
*NOx	< 5 ppm

27.1.2 The Carbon monoxide (CO) to Carbon dioxide (CO_2) ratio of the exhaust gases of each canister, while burning with blue flame, shall not exceed 0.02.

27.2 Exposure to Methanol Vapour

Methanol vapour concentrations shall be measured using (Refer Annexure F-1 & Annexure F-2) direct reading gas detection tubes such as colorimetric detection tubes, or with electronic instruments such as portable gas monitors. Gas monitors shall provide continuous readings of methanol concentrations, and alarms can also be set at specified concentrations. TWA (Time Weighted Average) personal exposure concentrations shall also be measured using an air sampling pump with silica gel sorbent tubes. The amount of methanol vapour in confined space with single unit of stove (consisting of single or multiple canisters as the case may be) with unsealed cassette / cassettes shall be less than 200 ppm. The purity level of Methanol for this safe limit (200 ppm) shall be within a range of 96 to 99 percent.

NOTE — Currently, the OSHA (Occupational Safety and Health Administration) PEL (Permissible Exposure Limit) and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for methanol are set at 200 ppm*. Both values are based on an 8 hour TWA (Time Weighted Average) exposure. The ACGIH short-term exposure limit for methanol is 250 ppm, and it contains a skin notation. The National Institute for Occupational Safety and Health (NIOSH) has also set a 10 hour TWA recommended exposure limit at 200 ppm.

Occupational Exposure Limits	*Short Term Exposure Limit (STEL)	< 250 ppm
	*Time Weighted Average (TWA) Continuous exposure	< 200 ppm
*Permissible Exposure Limits		< 200 ppm

NOTE — *American Conference of Governmental Industrial Hygienists, 2001. Methanol – Documentation for the Threshold Limit Value.

27.3 Standard Instructions related to Toxicity to be Mentioned in the Canister/Cookstove by manufacturer as the Product is for Domestic use:

Hazard Category, Exposure limit, First Aid procedures are to be mentioned on the Canister in line with OSHA

Hazard Categories List (Yes/No)

Hazardous Chemical: Yes

Immediate Hazard: Yes

Delayed Hazard: Yes

Fire Hazard: Yes

Pressure Hazard: No

Exposure Limits: ACGIH: TWA: 200 ppm STEL: 250 ppm BEL: 15 mg/l OSHA: PEL: 200 ppm 260 mg/m^3

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
517: 2020	Specification for methanol (methyl alcohol) (*third revis*ion)
6911:2017	Stainless Steel Plate, Sheet and Strip specification (*second revis*ion)
1070:1992	Reagent grade water — Specification (*third revision*)
5116: 2020	Domestic and commercial equipment for use with LPG — General requirements (*fourth revision*)
3144:1992	Mineral wool thermal insulation materials — Method of test (*second revision*)
3203:1982	Methods for testing local thickness of electroplated coatings (*first revision*)
6910:1985	Method of testing corrosion resistance of electroplated and anodized Aluminum coatings by acetic acid salt spray test (*first revision*)
6009:1970	Method for evaluation of results of accelerated corrosion tests
4905:2015	Methods for random sampling

ANNEX B

(*Clause* 13)

STRENGTH AND RIGIDITY TEST

B-1 PROCEDURE

B-1.1 The rubber support (grommet) if any, shall be removed and replaced with identical metal supports. The pan support and canister shall be removed and the distance between the sides of the cookstove body being tested shall be measured. A reference reading of the top surface of the body and the center of the width shall be taken. A load of 250 N (25 kg) per canister shall be applied at the top surface subject to a minimum load of 500 N (50 kg) for a single canister stove. The load shall be applied without impact to a strip of steel having 20 mm thickness, 100 mm width along the length of the appliance (*see* Fig. 3). This strip shall be placed in the center of the top surface of the cookstove and its length shall be parallel to the front. The load shall be maintained for 5 min after which the measurement for deflection at top surface of body (at the center of the width just in front of the strip) shall be taken with the load in position.

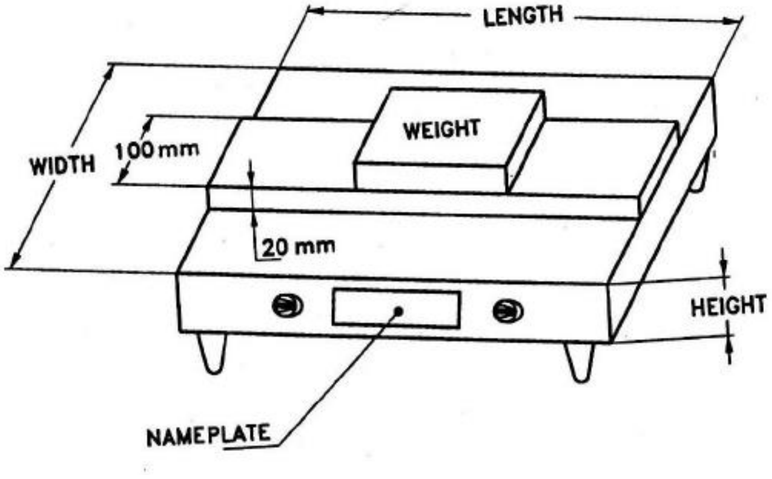


FIG. 3 STRENGTH TEST

ANNEX C

(*Clauses* 15 *and* 16)

TEST FOR THERMAL EFFICIENCY

C-1 THERMAL EFFICIENCY

Thermal efficiency of a cookstove may be defined as ratio of the heat actually utilized to the heat theoretically produced by complete combustion of a given quantity of fuel (which is based on the low calorific value of the fuel).

C-2 CONDITIONS FOR CARRYING OUT THERMAL EFFICIENCY TEST

C-2.1 Test Room Conditions

The air of the test room shall be free from draught likely to affect the performance of the cookstove. The room temperature shall be maintained in the range of 25 ºC to 30 ºC.

At the start of the test, the cookstove and the methanol in its canister shall be at room temperature.

C-2.2 Methanol

The methanol to be used in conducting the test shall conform to IS 517.

C-2.3 Setting of the Cookstove

The cookstove whose efficiency is to be determined shall be fitted with a canister of corresponding designation. Prior to the test, the cookstove shall be checked and examined to ensure that all components are undamaged and properly assembled according to the manufacturer's instructions. The cookstove shall be lighted and allowed to burn for 5 min at normal atmospheric pressure during which a stable flame shall be obtained. Now a vessel containing water shall be placed on the cookstove.

In the manner prescribed above, the cookstove shall be operated for a period of approximately two hours during which it shall be observed for any abnormal performance or leakage (this test should be done in draught-free room).

C-3 METHOD OF TEST

C-3.1 Normal Evaporation Test

Mineral wool packing should be done in such a way that the normal evaporation rate of methanol should be in the range of 10 to 15 g/h, when the canister is open to atmosphere without burning.

C-3.2 Fuel Consumption Test

The cookstove, whose efficiency is to be determined, canister shall be filled upto 100% of its nominal capacity. The cookstove shall be lighted with one burner at a time and brought to working within five min. After burning for 5 min, the lighted cookstove shall be weighed on a sensitive balance with an accuracy of one gram and the initial weight shall be noted. The cookstove shall be allowed to burn for one hour with an aluminium pan having sufficient water in it. At the end of one hour, weight of the burning cookstove shall be noted after removing the aluminium pan. The difference in the initial and final weights of the burning cookstove shall give the methanol consumption rate in gram per hour. A suitable pan for the cookstove under test shall be in accordance with Table 1.

C-3.3 A cylindrical flat-bottomed aluminium pan provided with an aluminium lid shall be used for this purpose. The lid shall have two holes, one for inserting the cork for holding a thermocouple and the other for the stirrer (made of aluminium wire) required for stirring the water.

C-3.4 Thermal Efficiency Test

Canister selected for thermal efficiency test shall be fully charged with methanol. The methanol cookstove shall be allowed to run for 5 min to obtain the steady flame height. Then, the stove along with two filled canisters shall be placed on the weighing balance of accuracy ± 1 g for measuring the initial weight of the stove. After measuring the weight, the stove shall be placed on the even surface. The aluminum pan filled with the required amount of water (4 kg) along with the lid and the stirrer are kept on the stove. Initial temperature of the water shall be noted. The initial temperature of water shall be kept within ±2°C from the actual room temperature. Water is heated and once the water temperature reaches 80°C, for uniformity in temperature, stirring shall be started and continued until the end of the test when the temperature of the water reaches to 90 ± 0.5°C. As soon as the temperature of the water reaches 90 ±0.5°C, the stove shall be switched off and the pan along with the lid and the stirrer is taken out of the stove. The final weight of the stove along with two canisters is measured. The difference between the initial and the final weights of the cookstove along with two canister gives the fuel consumption. The pan shall be covered with a lid fitted with a calibrated T-type thermocouple probe inserted into the cork in such a way that the probe of the thermocouple is immersed completely in the water of the vessel. The thermometer shall be digital, with T type thermocouple probe suitable for immersion in liquids with an accuracy of ± 0.5 ºC. The free end of the stirrer shall come out of the lid.

NOTES

1) The water stirred gently during heating.
2) Distilled water (*see* IS 1070) shall be used for test.
3) The pan shall be cylindrical with flat bottom.
4) The finish of the pan bottom from inside shall always be bright.

Table 1 Aluminium Vessels for Thermal Efficiency Test

(*Clause* C-3.2 *and* C-3.4)

Sl No.	**Consumption Rate g/h**	**Pan Diameter (external), mm ± 5%**	**Pan height (external), mm ± 5%**	**Total pan mass with lid, g ± 10%**	**Mass of water in pan, kg**
(1)	(2)	(3)	(4)	(5)	(6)
1	180-290	230	120	701	4

C-4 CALCULATION

Thermal efficiency of the cookstove shall be calculated as follows:

Heat gained by vessel = $M * C_p(T_2 - T_1)$, kJ
Heat utilized for heating water = $m * C_w(T_2 - T_1), k$J
Total heat utilized = $\left(M * C_p + m * C_w\right)(T_2 - T_1)$, kJ
Heat produced by fuel = $W * CV$, kJ

Thermal efficiency $= \frac{Total\ Heat\ utilized}{Heat\ produced\ by\ fuel}$

$$= \frac{\left(M*C_p+m*C_w\right)(T_2-T_1)}{W*CV} \times 100$$

Where:

M = Mass of the vessel with lid and stirrer, kg;
m = Mass of water in pan, kg;
W = Fuel consumed, kg;
C_p = Specific heat of aluminum, kJ/kg-K;
C_w = Specific heat of water, kJ/kg-K;
T_1 = Initial temperature of water in pan; ºC;
T_2 = Final temperature of water in pan; ºC;
CV = Low calorific value of fuel, kJ/kg.

NOTES
1. Specific heat of aluminum is 0.895 kJ/kg-K.
2. Low calorific value of methanol should be measured at actual condition using bomb calorimeter.

C-5 SHUTTING OFF THE COOKSTOVE TEST

Fill the canister to its full capacity and light the burner and adjust the flame to the highest level. Place the pot filled with 3 litre of water on the cooking surface of the cookstove. After burning the cookstove for 1 h, turn the lever to the “OFF” position and simultaneously start a stopwatch. After 5second, turn the flame regulator to the “ON” position and check that the flame has been extinguished.

C-6 DURABILITY TEST

Ignite the cookstove and adjust the flame to its highest level. Allow each canister inside the stove body to burn at this rate for 4 h. After this period, allow the canister to cool down to room temperature. Repeat this procedure for 5 times. Leave the canister for 1 h to cool down, thereafter, inspect the cookstove and its components for any damages.

ANNEX D

(*Clause* 17)

METHOD OF MEASUREMENT OF SURFACE TEMPERATURE

D-1 PREPARATION OF COOKSTOVE

The cookstove shall be tested with the fully filled canister. The cookstove shall be lit and run at the full output (at normal atmospheric pressure) for one hour with the vessel containing water placed over it before measuring the temperature.

D-2 PROCEDURE

D-2.1 The temperature of all parts of the cookstove which may be needed to be touched during its operation shall be measured by using a calibrated T type thermocouple or RTD having accuracy ± 0.5°C. The temperature of each such part shall be measured thrice for every 30 min to get three concordant readings. While measuring the temperature, T type thermocouple/RTD's measuring bead should be in perfect contact with the specific part for sufficient period of time, until maximum temperature is reached.

D-2.2 During the operation of the cookstove under **D-2.1**, the maximum temperature of canister shall also be recorded. The final reading shall be taken at the end of three hours of running or operation of cookstove.

D-2.3 The temperature of mineral wool surface temperature shall be measured by calibrated T type thermocouple of having accuracy ± 0.5 °C immediately after switching off the canister.

ANNEX E

(*Clauses* 18 & 27.1)

TEST FOR COMBUSTION EFFICIENCY

E-1 EQUIPMENT

E-1.1 The cookstove shall be tested with its fuel canister fully filled with methanol. Before starting the test, a pan of the type and size as described in **C-3.2** and containing water sufficient for the test shall be placed over the canister. In addition, a collecting hood (*see* Fig. 4) suitable for cookstove under examination shall be used.

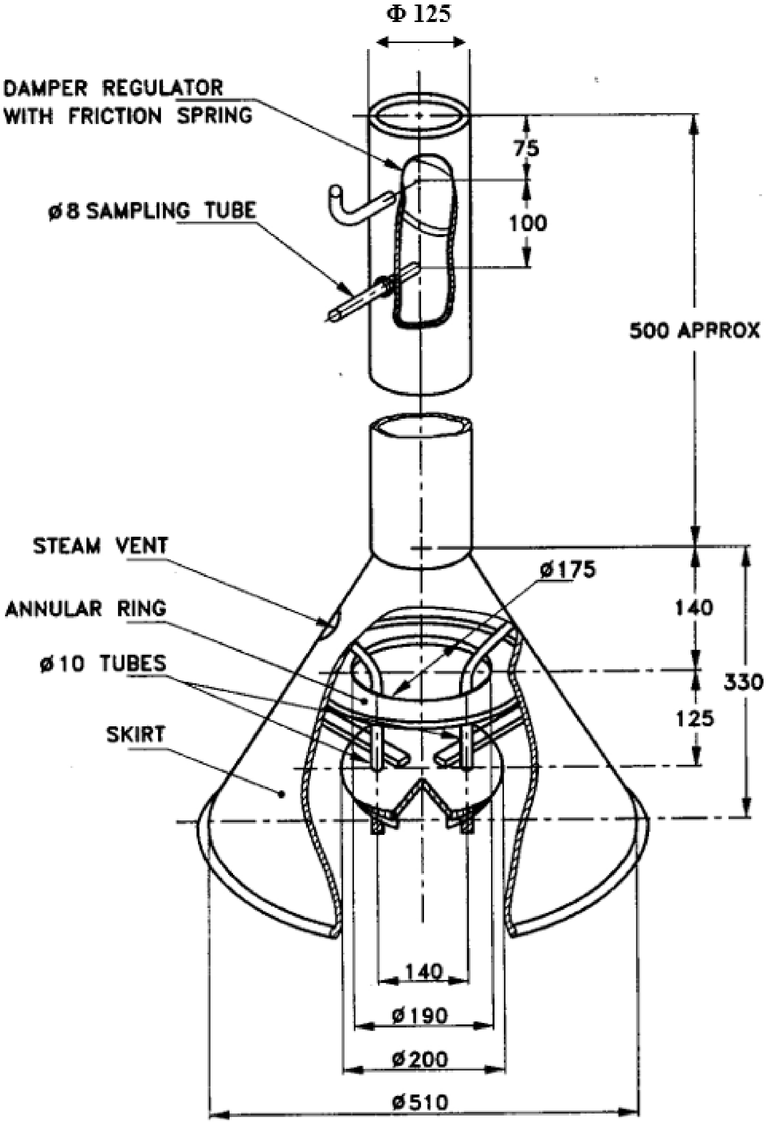
E-1.1.1 The hood shall be so designed that, while not interfering in any way with the normal combustion of the canister it collects a fairly high proportion of the flue gases. Also, it shall be such that the sample collected represents the whole of combustion gases and not those from one particular point. When using hood, the damper provided shall be set, or an additional flue pipe added, so that spillage of the flue gases around the skirt is minimized.

E-2 PROCEDURE

E-2.1 With the hood in position over the cookstove under investigation, the cookstove shall be lit and run for few minutes till a stable flame is achieved. Then, a sufficient number of samples shall be collected.

E-2.2 The flue gas shall be analyzed by using any of the recognized methods. For carbon monoxide, it is recommended that co-indicator of prescribed accuracy or iodine pentoxide method or catalytic method, for example, Drager method, the Katz method or infra-red analysis method may be used. Carbon dioxide may be tested by using Orsat apparatus, or Haldane apparatus, or by the infra-red analysis.

E-2.3 The carbon monoxide and carbon dioxide content of the product of combustion shall be determined by the methods capable of an accuracy of 0.001 percent and 0.5 percent of the volume of the sample respectively.



All dimensions specified are optional. All dimensions are in millimeters.

FIG. 4 HOOD FOR METHANOL COOKSTOVE

ANNEX F-1

(*Clause* 27.2)

METHOD OF MEASUREMENT OF METHANOL VAPOUR CONCENTRATION (WITH GAS CHROMATOGRAPHY TECHNIQUE)

F-1.1 METHOD NUMBER

2000*

NOTE — Test method has been derived from NIOSH 2000.

F-1.2 VALIDATED ANALYTE

Methyl alcohol

F-1.3 REAGENTS AND EQUIPMENT

REAGENTS:

a) Methanol, chromatographic grade.
b) Water, distilled and pre-purified.
c) Isopropanol (IPA), chromatographic grade.
d) Helium, purified.
e) Hydrogen, pre-purified.
f) Air, filtered.
g) Desorbing solution, 5% isopropanol in 95% distilled water.
h) Calibration stock solution, 2µg/µl. Add 25.3µL methanol to 10 ml of desorbing solution.

EQUIPMENT

a) Sampler: silica gel tube, 7 cm long, 4 mm ID, containing two sections of 20/40 mesh silica gel (front = 100 mg, back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section. A 4 mm foam plug follows the back section. Samplers are commercially available.
b) Personal sampling pump, 0.02 to 0.2 l/min, with flexible connecting tubing.
c) Gas chromatograph, flame ionization detection, integrator, and Rtx-35 capillary column, or equivalent.
d) Ultrasonic bath.
e) Vials, auto sampler, with PTFE-lined caps.
f) Micro liter syringes, 10-µL and other sizes as needed, readable to 0.1 µl.
g) Flasks, volumetric, various sizes.
h) Pipets, various sizes.

F-1.4 SAMPLING PROCEDURE

Collect air sample by drawing workplace air through sampler (silica gel, 100/50 mg). Extract sample by desorption with water/isopropanol (95:5), and analyze it by gas chromatography (GC) using a flame Ionization detector.

F-1.4.1 Sampling

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Collect the sample at an accurately known flow rate between 0.02 and 0.2 l/min for total sample size of 1 to 5 l.
4. Cap the sampler with plastic caps and pack securely for shipment.

The following condition is requiring for sampling of methanol:

Sampler	Solid sorbent tube (silica gel, 100/50 mg)
Flow rate	0.02 to 0.2 l/min
Vol- Min	1 l < 200 ppm
Vol- Max	5 l >200 ppm
Shipment	pack securely for shipment; store at 5°C
Sample stability	at least 30 day at 5°C
Blank	Nitrogen gas, or zero air

F-1.4.2 Sample Preparation

a) Place front (include glass wool plug) and back sorbent sections of the sampler tube in separate vials. Discard foam plugs.
b) Add 1 ml of water/IPA (95/5) to each vial and attach crimp caps.
c) Place vials in an ultrasonic bath for 30 to 60 min to aid desorption.

F-1.4.3 Calibration and Quality Control

1. Calibrate daily with at least three working standards over the range of interest. Three standards should cover the range from LOD to LOQ.

    a) Add known amounts of calibration stock solution to water/isopraponol (95/5) in 10 ml volumetric flasks and dilute to the mark.
    b) Analyse together with samples and blanks.
    c) Prepare calibration graph (peak area or height vs. µg methanol).

2. Determine desorption efficiency (DE) at least once, for each lot of silica gel tubes used for sampling in the calibration range. Prepare three samplers at each of six levels plus three media blanks.

    a) Remove and discard back sorbent sections of samplers and media blanks.
    b) Inject a known amount of calibration stock solution directly into the front sorbent bed of each silica gel tube.
    c) Allow the tubes to air-equilibrate for several min, then cap the ends of the tubes and allow to stand overnight.
    d) Desorb the samples and analyze together with working standards and blanks.
    e) Prepare a graph of DE vs. µg analyte recovered.

3. Analyze three quality control blind spikes and three analyst spikes to ensure that the calibration graph and DE graphs are in control**.**

F-1.5 MEASUREMENT TECHNIQUE

Technique	Gas Chromatography, FID
Analyte	Methanol
Desorption	1 ml water/isopropanol (95:5)
Injection volume	1 µl
Temperature-Injection	250°C
Temperature-Detector	300°C.
Temperature - Column	50 to 90 C (8°C/min) (Split Ratio 10:1)
Carrier gas	He, 2.6 ml/min
Column	Capillary, 30 m × 0.53 mm ID; 3µm film 35% diphenyl-65% dimethyl polysilozane, Rtx™-35 or equivalent
Calibration	Standard solutions of methanol in water/isopropanol (95:5)
Range	2.2 to 6000 µg per sample
Estimated load	0.7 µg per sample
Precision	0.030

F- 1.5.1 Set gas chromatograph according to the above mentioned conditions. Inject a 1-µL sample aliquot manually using solvent flush technique or with an auto-sampler and measure peak areas.

NOTE — If peak area is above the linear range of the working standards, dilute with water/IPA (95/5), reanalyse and apply the appropriate dilution factor in the calculations.

F-1.6 CALCULATIONS

F-1.6.1 Determine the mass, µg (corrected for DE), for methanol found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blank front (B_f) and back (B_b)sorbent sections.

NOTE —If $W_b > W_f/10$, report breakthrough and possible sample loss.

F-1.6.2 Calculate concentration, C (mg/m^3), of methanol in the air volume samples, V (L)

$$C = \frac{W_f + W_b - B_f - B_b}{V}$$

F-1.7 SPECIAL PRECAUTIONS

Methanol is flammable and dangerous, it has risk of fire and explosion. It is moderately toxic on ingestion and inhalation. Isopropanol is flammable and is a fire risk. Wear appropriate protective clothing and work with these compounds in a well ventilated hood.

ANNEX F-2

(*Clause* 27.2)

METHOD OF MEASUREMENT OF METHANOL VAPOUR CONCENTRATION (WITH GAS CHROMATOGRAPHY TECHNIQUE)

F-2.1 METHOD NUMBER

5001*

NOTE — Test method has been derived from NIOSH 5001.

F-2.2 SAMPLING PROCEDURE

F-2.2.1 Sample Collection

All safety practices shall be followed during collection of samples. Attach sampling equipment to the worker in a manner that will not interfere with work performance and safety. Collect air samples by drawing workplace air through two Anasorb 747 sorbent tubes connected in series. Extract samples with 60/40 (v/v) N,N-dimethyl formamide/carbon disulfide (DMF/CS2) and analyze by gas chromatography (GC) using a flame ionization detector (FID).

F-2.2.2 Recommended sampling time and sampling rate

a) 100 min at 50 ml/min (5 l) if relative humidity is > 50% at 25 °C
b) 60 min at 50 ml/min (3 l) if relative humidity is < 50% at 25 °C

F-2.2.3 Apparatus

1. Two single section 8 mm × 110 mm glass sampling tubes packed with Anasorb 747 sorbent are connected in series with a 1-inch length of ¼ -inch inner diameter silicone tubing. The front tube contains 400 mg and the back tube contains 200 mg of Anasorb 747. The sorbent is held in place with glass wool on the inlet side and a foam plug on the outlet side. Commercially prepared tube sets may be purchased from SKC Inc. (catalog no. 226-82).

2. A sampling tube holder, such as SKC Inc. Tube Cover D (catalog no. 224-29D), is used to protect the worker from the sharp ends of the glass sampling tubes.

3. A personal sampling pump calibrated within ±5% of the recommended flow rate is used with a representative sampling device in-line.

F-2.2.4 Reagents

None required

F-2.2.5 Measurement Technique

1. Immediately before sampling, break off the ends of the 400 mg and 200 mg flame-sealed tubes to provide an opening approximately half the internal diameter of the tube. Connect the outlet end of the 400-mg tube to the inlet end of the 200 mg tube with a 1 inch length of ¼ inch i.d. silicone tubing. Place tubes into a sampling tube holder to minimize the hazard to the worker from the broken ends of the tubes. All tubes should be from the same lot.

2. Attach the tube holder (with the adsorbent tubes) to the sampling pump so that the adsorbent tube is in the worker's breathing zone during sampling. Position the sampling pump, tube holder, and tubing so they do not impede work performance or safety. The air being sampled should not pass through any hose or tubing before entering the sampling tube.

3. Sample at 50 ml/min for 100 min (5 l) when the relative humidity is above 50%, and for 60 min (3 l) when the relative humidity is below 50%. The recommended air sample volume for the given sample must be reduced at lower relative humidity because sampler capacity is reduced. Fifty-percent relative humidity at 25 °C (11.5 mg of water per liter of air) was selected as the point at which the recommended air volume is reduced, as this will provide a sufficient margin of safety against sampler saturation. It is anticipated that most samples will be collected at relative humidity greater than 50% at 25 °C.

4. After sampling for the appropriate time, separate the two samplers and seal each tube with plastic end-caps. Seal each sample end-to-end with a Form OSHA-21 as soon as possible.

5. Submit at least one blank sample with each set of samples. Handle the blank sample in the same manner as the other samples except that no air is drawn from it.

6. Record sample air volume (liters), sampling time (min) and sampling rate (ml/min) for each sample, along with any potential interference on the Form OSHA-91A.

7. Submit the samples to the laboratory for analysis as soon as possible after sampling. If delay is unavoidable, store the samples in a refrigerator as a precaution.

F-2.3 ANALYTICAL PROCEDURE

F-2.3.1 Apparatus

a) Mechanical vial rotator
b) One-litre amber glass solvent dispenser capable of dispensing 2.0 ml
c) Class A volumetric flask (2 and 500 ml)
d) Amber glass vials with PTFE-lined screw caps (2 and 4ml)
e) GC instrument with FID

F-2.3.2 Reagents

Methyl alcohol (>99% purity, analytical grade)

F-2.3.3 Reagent Preparation

Extraction solvent (60/40 (v/v) DMF/CS2 with 1 octanol): To a 500 ml volumetric flask add 300 ml of N,N dimethyl form amide, 1 ml of 1-octanol, then carbon disulfide to the mark indicated. Immediately mix the solution and transfer to an amber glass solvent dispenser. The 1-octanol is added as an internal standard (ISTD).

F-2.3.4 Standard Preparation

Prepare calibration standards by injecting micro liter amounts of the neat chemical into various 2 ml volumetric flasks containing approximately 1 ml of the extraction solvent which contains the ISTD. Fill to the mark with extraction solvent, mix, and transfer to 2 ml amber glass auto-sampler vials. Multiple analytes in one calibration standard can significantly dilute the final concentration of the ISTD when it is pre-mixed with the extraction solvent. To minimize this effect on the calibration, correct the ISTD concentration for each standard when calibrating.

F-2.3.5 Sample Preparation

1. Remove the plastic end-caps from the 400-mg and 200-mg sample tubes. Transfer the respective 400 and 200 mg Anasorb 747 sections into separate 4-ml vials. Discard glass tubes, foam, and glass wool plugs.

2. Add 2.0 ml of extraction solvent containing ISTD to each vial and immediately seal with PTFE-lined caps.

3. Extract the samples by rotating for 1 h.

4. Transfer the extraction solution in each 4ml vial to a 2ml amber glass auto-sampler vial and seal with PTFE-lined caps.

F-2.3.6 Analysis

Analyze sample using a GC-FID instrument and the analytical conditions described below. Use an ISTD calibration method. For analyte construct a least-square linear regression curve by plotting ISTD corrected responses of standard injections versus micrograms of analyte per sample. A weighted least-square linear regression, using a 1/x weight, can also be used. Confirm the presence of analytes when an OSHA Permissible Exposure Limit (PEL) value has been exceeded, as described in **F-3.8**.

GC Conditions:

Column:	Agilent J&W DB-WAX capillary column, 60 m × 0.32 mm ID, 0.5 µm film, or equivalent
	Restek Topaz 4.0 mm ID Precision Inlet Liner w/wool (Restek catalog no. 23305, or equivalent)
Carrier	hydrogen, 2 ml/min, constant flow mode
Septum purge	hydrogen, 3.0 ml/min
Injection	1.0 µl, split injection (150:1 ratio)
Inlet temperature	235 °C
Oven temperature	40 °C (hold 4 min), ramp to 70 °C at 5 °C/min (hold 0 min), ramp to 205 °C at 15 °C/min (hold 0 min), ramp to 240 °C at 35 °C/min (hold 0 min)
Run time	20 min
Retention time	7.88 min
Detector temperature	240 °C
Hydrogen flow	40 ml/min
Air flow	450 ml/min
Nitrogen make up flow	45 ml/min

F-2.3.7 Calculations

Calculate the micrograms recovered per sample (m) for each analyte. The back sorbent section is analyzed primarily to determine the extent of sampler saturation. If any analyte is found on the back section, it is added to the amount found on the front section. If more than 20% of the total amount is found on the back section, report that the sampler may have been saturated. Correct m for each sample by subtracting the mass of analyte (if any) found on the sample blank. The analyte air concentration, C is calculated in mass per volume units (mg/m^3) using Equation 1, where V is the volume of air sampled (L), and E_E is the extraction efficiency expressed in decimal format.

$$C = \frac{m}{VE_E} \qquad \text{....Equation 1}$$

The air concentration (C_{ppm}) in terms of parts of analytevapour per million parts of air (ppm) is obtained using Equation 2, where C is the air concentration with mass per volume units (mg/m^3) calculated in Equation 1, $V_M$is the molar volume of an ideal gas or vapour at 25 °C and 760 torr (24.46 L/mol), and $M$is the analyte molar mass (g/mol).

$$C_{ppm} = \frac{V_M C}{M} \qquad \text{....Equation 2}$$

F-2.3.8 Qualitative Analysis

When necessary, the identity of an analyte peak can be confirmed by gas chromatography – mass spectrometry (GC-MS) using the analytical conditions described below. Confirm the presence of an analyte by matching the retention time and fragmentation pattern of a standard at a similar concentration.

GC Conditions:

Column	Agilent J&W DB-WAX capillary column, 60 m × 0.32mm ID, 0.5 µm film, or equivalent
Inlet liner	Restek Topaz 4.0 mm ID Precision Inlet Liner w/wool (Restek catalog no. 23305, or equivalent)
Carrier	helium, 1.6 ml/min, constant flow mode
Septum purge	helium, 3.0 ml/min
Injection	1.0 µl, split injection (150:1 ratio)
Inlet temperature	235 °C
Oven temperature	40 °C (hold 4.15 min), ramp to 70 °C at 4.7 °C/min (hold 0 min), ramp to 205 °C at 13 °C/min (hold 0 min), ramp to 240 °C at 35 °C/min (hold 0 min)
Run time	21.9 min
Retention time	7.75 min
Mode	Electron ionization (EI)
Acquistion mode	scan, m/z 20 – 150
Solvent delay	6 min
Timed events	17.8 – 18.20 min MS Off
EMV mode	Gain factor
Temperature	250 °C (source), 200 °C (quadrupole assembly), 250 °C (transfer line)

ANNEX G

(*Foreword*)

COMMITTEE COMPOSITION

Oil Burning Appliances Sectional Committee, MED 26

Organization	*Representatives*
Indian Institute of Petroleum, Dehradun	DR G D THAKRE (***Chairman***)
Bharat Petroleum Corporation Limited, Mumbai	SHRI RAHUL GARG SHRI CHITHRAVISHWANATH (*Alternate*)
Bombay Light and Stove Merchants Association, Mumbai	SHRI MAHESH D BAKHAI
CSIR-Indian Institute of Petroleum, Dehradun	SHRI PANKAJ KUMAR ARYA SHRI SATISH KUMAR (*Alternate*)
Centre of Technology for Sustainable Development, Faridabad	DR S P DUBEY SHRI R K PAULASTYA (*Alternate*)
Consumer Research, Education, Action, Training and Empowerment, Tamil Nadu	DR P DURAISINGAM
Directorate General of Quality Assurance, Ministry of Defence, Kanpur	SHRI M V KUMBHALKAR SHRI R K BORUAH (*Alternate-1*) SHRI S J KOLARKAR (*Alternate-2*)
Directorate General of Supplies and Disposals (Quality Assurance Wing), New Delhi	SHRI A K RAI
Indian Institute of Technology Guwahati, Guwahati	SHRI MUTHU KUMAR SHRI PRATIBHA MAURYA (*Alternate*)
Indian Oil Corporation (R & D Centre), Faridabad	SHRI R. MAHAPATRA DR S SINGH (*Alternate*)
LPG Equipment Research Centre, Bengaluru	SHRI A K BERA SHRI P R DEODHAR (*Alternate*-1) SHRI RAHUL SHARMA (*Alternate*-2)
Office of Development Commissioner (MSME), New Delhi	SHRI SUSANTA KUMAR SOM MS MAITREYEE TALAPATRA (*Alternate*)

Organization	*Representatives*
Petroleum Conservation Research Association, New Delhi	SHRI SUNIL BAHL SHRI RAMESHWAR K SHARMA (*Alternate*)
Premier Industrial Corporation, Coimbatore	SHRI R SHYAM SUNDER SHRI R SIVA KUMAR(*Alternate*)
R K Products, Madurai	SHRI K C KASSI
The Scindia Kerosene Wick Stove Manufacturers Association, Madurai	SHRI T CHIDAMBARAM
BIS Directorate General	SHRI RAJNEESH KHOSLA SCIENTIST E AND HEAD (MED) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri Aman Dhanawat
Scientist B (MED), BIS

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Review of Indian Standards

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This Indian Standard has been developed from Doc No.: MED 26(18115).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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